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DETERRING AND DISSUADING IN SPACE: A SYSTEMS APPROACH

BY

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USAWC STRATEGY RESEARCH PROJECT

DETERRING AND DISSUADING IN SPACE: A SYSTEMS APPROACH

by

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ABSTRACT

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Space capabilities have improved life in the United States and around the world, enhanced security, protected lives and the environment, sped information flow, served as an engine for economic growth, and revolutionized the way people view their place in the world. In fact, the need to ensure those vital space capabilities are available has never been greater. This paper examines the importance space capabilities play in military and civil activities. It evaluates the concepts of dissuasion and deterrence, identifying the importance of each in a new defense policy spectrum. It addresses space control operations, the means used to ensure friendly access to necessary space capabilities and to deny the same to an adversary. Finally, the paper proposes a systems approach to the characterization of the operational environment. Dissuasion and deterrence play vital roles preventing potential adversaries from challenging our space capabilities, and a systems approach to space control policies and actions provides valuable insight into the second- and third-order effects that result in the highly volatile, uncertain, complex, and ambiguous security environment of the 21st century.

DETERRING AND DISSUADING IN SPACE: A SYSTEMS APPROACH

In January 2007, the world took notice when China launched a direct-ascent anti-satellite (ASAT) weapon and destroyed a weather satellite in low Earth orbit (LEO).[1] In February 2008, the world again was reminded of the vulnerability of satellites and, by extension space capabilities, when a U.S. Navy ship destroyed a failed U.S. reconnaissance satellite with a missile originally designed for a missile defense role.[2]

These were not, however, the first examples of ASAT technology. The U.S. Air Force operated a direct ascent nuclear ASAT system, Program 437, from 1963 to 1975 made up of deactivated missile components, existing launch pads, and a space tracking system.[3] During the 1980s, the two Cold War superpowers each demonstrated new ASAT technologies. The United States demonstrated an air-launched, direct-ascent ASAT and the Soviet Union demonstrated a ground-launched co-orbital system.[4] Additionally, the Soviet Union's nuclear-armed GALOSH anti-ballistic missile interceptor deployed around Moscow had, like the interceptors of Program 437, an inherent ASAT capability against low altitude satellites.[5] In other words, threats to space systems and their associated capabilities have been around for a long time.

In 1963, the dependencies on the capabilities provided from and through space were just emerging, but in 2008, both military and civilian examples of dependency on space capabilities are prevalent. Given these dependencies, the ability to ensure such capabilities are available when and where needed becomes a vital national interest and is identified as such in the U.S. National Space Policy published in 2006.[6]

This paper begins with a look at those dependencies and their link to national policy. It then delves into the concepts of deterrence and dissuasion, placing them on a

spectrum of defense policy. It then addresses the military construct of space control operations and the specific space control missions associated with dissuading, deterring, and defeating adversaries who may threaten our space superiority. Finally, it offers a system-of-systems approach to understand the operational environment and applies that framework to the development of space control operations. Deterrence and dissuasion play vital roles preventing potential adversaries from challenging our space capabilities, and a systems approach to space control policies and actions provides a systematic method for identifying and considering the second- and third-order effects that may result in the highly volatile, uncertain, complex, and ambiguous security environment of the 21st century.

Space Capabilities--Vital National Interests

Today, space capabilities directly enable U.S. military operations in more ways than ever before, and in many cases very transparently. Consider just two of those capabilities: the precision navigation and timing provided by the Global Positioning System (GPS) and the ability to move large amounts of information on a global scale utilizing satellite communications (SATCOM). First used operationally during Operation Desert Storm, the application of all-weather GPS navigation to guided munitions transformed precision attack from the air, but only 8 percent of the munitions utilized GPS guidance. In 2003, GPS precision guided munitions made up 68 percent of the munitions used in the initial phases of Operation Iraqi Freedom and GPS was also a vital asset in the prevention of fratricide, effectiveness of close air support, and the ability to successfully visualize the twenty-first century battlefields of Iraq and Afghanistan using blue force tracking technology.[7]

The transparent and integrated use of both tactical and strategic SATCOM has also revolutionized modern warfare. Again looking back to Operation Desert Storm, the SATCOM usage was approximately one megabit per second (Mbps) for every 5,000 troops deployed. In 2003, that value ballooned to 68.2 Mbps for Operation Enduring Freedom and 51.1 Mbps for Operation Iraqi Freedom.[8] That massive SATCOM capability enabled a vast array of applications, including widely distributed, real-time command and control (C2) of combat and humanitarian operations and live data feeds from unmanned aerial vehicles (UAV) like Predator and Global Hawk operated from outside the area of responsibility (AOR), to include the continental United States (CONUS).[9]

Our reliance on space systems is not, however, limited to military applications. The commander of U.S. Strategic Command recently pointed out the impact of precision GPS navigation on key industries, such as trucking and warehousing, manufacturing, mining, and agriculture. From an economic point of view, international banking is heavily reliant on civilian space-based communication and precision timing systems. “A quick visit to Google Earth will reveal a wealth of information available, thanks to satellites, to anybody with a laptop.”[10] As Richard DalBello points out in his article on commercial satellite communications and vulnerability in a changing world, commercial space systems make up an important element of the critical U.S. infrastructure. For example, like other parts of that infrastructure (energy, the telecommunications network, or the transportation network), space capabilities play a critical role in disaster relief and recovery.[11] In 2006, a new National Space Policy further described the significance of civil, commercial, and national security space

capabilities and their impact on life in the United States and around the world. Space capabilities enhance security, protect lives and the environment, speed information flow, serve as an engine for economic growth, and revolutionize the way people view their place in the world. “In order to increase knowledge, discovery, economic prosperity, and to enhance the national security, the United States must have robust, effective, and efficient space capabilities.”[12] The policy does not only focus on the importance of space capabilities; it also offers principles to guide U.S. space programs.

The 2006 National Space Policy addresses the rights of passage through and operations in space in much the same way President Wilson identified the importance of freedom of navigation upon the seas in his famous “Fourteen Points” speech to Congress.[13] This policy makes clear the U.S. considers “space systems to have the rights of passage through and operations in space without interference” and states that “purposeful interference” will be considered an infringement on these rights. The policy also makes it clear that space capabilities, made of ground and space segments as well as the connecting links, are “vital to its national interests” and states the U.S. will:

- preserve its rights, capabilities, and freedom of action in space;
- dissuade or deter others from either impeding those rights or developing capabilities intended to do so;
- take those actions necessary to protect its space capabilities;
- respond to interference; and
- deny, if necessary, adversaries the use of space capabilities hostile to U.S. national interests.[14]

This paper focuses on the need to dissuade or deter potential adversaries with an end goal of protecting and defending U.S. space capabilities and a review of the

concepts of deterrence, dissuasion, and the relationship between the two is a logical place to begin that discussion.

Deterrence, Dissuasion, and 21st Century Defense Policy

Throughout the Cold War, the concept of deterrence held a place of primacy in international military strategy. Though threat-based policies of massive retaliation and mutually assured destruction gave way to theories like counterforce and flexible response, the underlying concept of deterrence--preventing action by generating fear of the consequences--remained relatively constant. Said another way, deterrence is "a state of mind brought about by the existence of a credible threat of unacceptable counteraction."[15] The 2006 U.S. National Security Strategy (NSS), however, identified the need for changes to the approach used to generate deterrence. "Our deterrence strategy no longer rests primarily on the grim premise of inflicting devastating consequences on potential foes. Both offenses and defenses are necessary to deter state and non-state actors, through denial of the objectives of their attacks and, if necessary, responding with overwhelming force."[16]

With these changes in mind, DOD published a Deterrence Operations (DO) Joint Operating Concept (JOC) in December 2006 that offered an updated definition of deterrence. "Deterrence operations convince adversaries not to take actions that threaten U.S. vital interests by means of decisive influence over their decision-making. Decisive influence is achieved by credibly threatening to deny benefits and/or impose costs while encouraging restraint by convincing the actor that restraint will result in an acceptable outcome."[17] In addition to the need to deter others from impeding U.S. rights, capabilities, and actions in space or developing capabilities intended to do so,

the 2006 National Space Policy also highlights the importance of another concept--dissuasion.

Merriam-Webster defines dissuade as “to advise against something” or “to turn from something by persuasion.”[18] Though not explicitly defined in DOD’s *Dictionary of Military and Associated Terms*, the DO JOC provides a more descriptive illustration of dissuasion, especially relative to the concept of deterrence. Effective dissuasion efforts shape the deterrence battlespace by convincing potential adversaries not to compete with the U.S. in certain areas of military capability, thus indirectly enhancing our own deterrence. Additionally, dissuasion aids in convincing adversaries that we can and will deny them the benefits of contemplated aggression in the pre-crisis, day-to-day peacetime period.[19] The 2005 National Defense Strategy (NDS) uniquely identifies the importance of dissuasion, distinct from deterrence, in the accomplishment of the national objectives set forth in the President’s NSS. The NDS outlines a continuum consisting of the necessity of assuring allies and friends, dissuading potential adversaries, deterring aggression and countering coercion, and defeating adversaries.[20]

David Meteyer effectively utilizes this continuum in his analysis of China’s development of capabilities specifically designed to deny access to space systems--counterspace capabilities--and that may therefore threaten U.S. national interests. Figure 1 illustrates his Defense Policy Spectrum and Illustrates two key points. First, the concept of dissuasion as a tool between assurance and deterrence is a relatively new concept. Without a policy of dissuasion specifically focused on reducing the number of threats, previous national policies waited for threats to develop and then dealt with them through deterrence or engagement.[21]

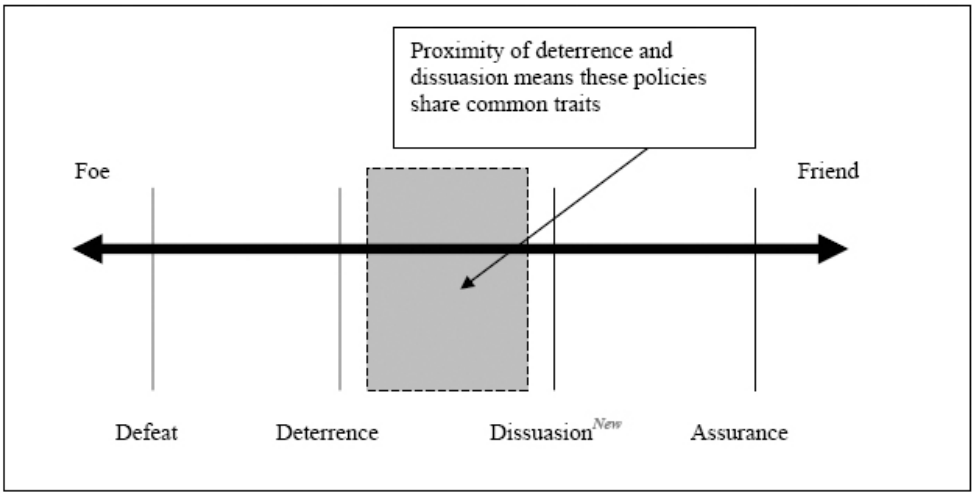

Figure 1. Defense Policy Spectrum[22]

The second point illustrated in Meteyer's Defense Policy Spectrum is the proximity of deterrence and dissuasion on the policy spectrum and the resultant commonality of traits between the two policies. In today's complex international security environment, states do not tend to fall consistently into the category of "friend" or "foe." The concept of dissuasion in recent national policy offers a potential alternative to assurance and deterrence with states that fall short of overt rivalry.[23] The close relationship between dissuasion and deterrence is reflected in the 2006 Quadrennial Defense Review (QDR), which described the need to dissuade military competitors from developing disruptive or other capabilities that could enable hostile action against the U.S. while deterring, in a tailored fashion that includes offensive and defensive capabilities, against the spectrum of 21st century threats.[24]

Ken Waltz, one of the most prominent international relations scholars, also addresses the relationship between deterrence and dissuasion when he answers the question, "How does one state dissuade another state from attacking." He answers with two possibilities (or the combination thereof)--a state dissuades by defense or by

deterrence or by a combination of the two. He points out that defenses can be made so strong no one will try to destroy or overcome them (Waltz's "defensive ideal"). Deterring an adversary, in contrast, operates by frightening a state out of attacking because the expected reaction from the state attacked will result in one's own severe punishment.[25] While Waltz's use of the term dissuasion may seem to differ from that used explicitly in the NDS or Meteyer's policy spectrum by including deterrence as a means for dissuading, it actually illustrates the close relationship of the two concepts and the difficulty clearly separating the two. The DO JOC reinforces that close relationship when it addresses deterrence impacts on the U.S. ability to dissuade a potential adversary. "Adversaries that perceive U.S. deterrence efforts and operations as effective may also be dissuaded from militarily competing with us in certain areas. For example, if U.S. deterrence efforts are successful, some adversaries may view the acquisition or maintenance of certain threatening capabilities as superfluous and excessively expensive."[26] Waltz also highlights the common confusion between defenses and deterrence, pointing out that defense does not deter.[27] Though defense may not deter, it does have significant applicability in the other half of that grey region in the policy spectrum, dissuasion.

Having examined the concepts of deterrence and dissuasion, the next step toward identifying how the U.S. can deter or dissuade potential adversaries from threatening U.S. access to vital space capabilities is a discussion of the space control mission area.

Space Control and Space Superiority[28]

Joint doctrine defines space control as "combat, combat support, and combat service support operations to ensure freedom of action in space for the United States

and its allies and, when directed, deny an adversary freedom of action in space."[29] In other words, gaining and maintaining space superiority through defensive and offensive space control operations, both of which depend on robust space situational awareness.

As in all military operations, situational awareness is fundamental to the ability to conduct space control operations. "Space situational awareness requires robust space surveillance of orbiting objects; real-time search and targeting-quality information; threat detection, identification, and location; predictive intelligence analysis of foreign capabilities and intent; and a global reporting capability for friendly space capabilities."[30] The space surveillance mission incorporates all those capabilities that detect, identify, assess, and track space objects and events to support space operations, both from space-based platforms as well as and terrestrial radars and optical sensors.

From a defensive perspective, the U.S. must be able to protect U.S. and friendly space systems. Given the U.S. dependency on space capabilities, it is reasonable to assume an adversary may attempt to negate those capabilities. The space control mission of protection utilizes both active and passive defensive measures to ensure U.S. and friendly systems perform as designed and overcome or minimize the effects of any negation attempts or environmental conditions. Protection measures may be applied to each segment of a space system and some examples include, but are not limited to ground facility protection, alternate nodes and spare satellites, link encryption, increased signal strength, satellite radiation hardening, and space debris protection.[31] The U.S. response to Iraqi efforts to jam GPS during Operation Iraqi Freedom provided a good example of defensive space control operations. The U.S. executed a coordinated targeting process and strike on the Iraqi jammers that eliminated the

threat.[32] Another defensive space control example is the near real-time event detection, characterization, geolocation, and electromagnetic interference reporting for satellite communications systems by U.S. Air Force space forces employing the Rapid Attack Identification Detection Reporting System (RAIDRS).[33]

On the other hand, offensive space control operations focus not on protecting U.S. or friendly capabilities but on the U.S. ability to both negate adversary space capabilities hostile to U.S. national interests and prevent an adversary's hostile use of U.S. or third party space systems and services--denying an adversary freedom of action in space. The negation mission includes measures to deceive, disrupt, deny, degrade, or destroy adversary space capabilities and can include action against the ground, link, or space segments of an adversary's space system.[34] An example of an offensive space control operation is the already mentioned Iraqi operation to deny GPS capability to U.S. forces through jamming--a reversible means of denying the precision navigation capability vital to U.S. precision strike operations. The Counter Communication System (CCS) operated by U.S. Air Force space forces provides another example of a capability that temporarily denies adversary space capabilities.[35] The ASAT systems referenced earlier were tools used for offensive space control missions, but instead of temporary denial of capabilities, they are a permanent means of destroying adversary space capabilities.

Offensive space control operations also prevent adversary access to U.S. or third party space capabilities and can include military, diplomatic, political, and economic measures.[36] Though the Iraqi army did not have organic space capabilities that provided overhead satellite imagery, it was available commercially in 1991. Rather than pursuing

a negation strategy whose impact may have had international consequences, the U.S.-led coalition negotiated an agreement with SPOT Image, a French company, well before the start of hostilities to prevent Saddam's access to vital imagery.[37] The U.S. National Imagery and Mapping Agency negotiated a similar agreement in 2001 in support of Operation Enduring Freedom.[38]

Ignoring the obvious role of defeating an adversary once deterrence has failed, what is the role of space control operations in the areas of deterrence and dissuasion as defined earlier? The defensive capabilities and operations that protect our space systems and capabilities combined with offensive capabilities to prevent a potential adversary from benefiting from those same types of capabilities may ultimately dissuade that state- or non-state actor from acquiring or developing the capabilities necessary to challenge and threaten our vital space capabilities. Additionally, given the changes to the concept of deterrence set forth in the 2006 NSS, both offensive and defensive space control operations can apply to a policy designed to deter an adversary from challenging our space capabilities. Protection, prevention, and negation capabilities all provide a piece of that "credible threat" necessary to deny benefits and impose costs while encouraging restraint by convincing the potential adversary that restraint will result in an acceptable outcome.

Determining that space control operations play a role in both deterrence and dissuasion, however, is not end of the process. Identifying where space control efforts should focus in order to deter or dissuade and recognizing the potential for second- and third-order effects are really the goal and a systems approach to that analysis provides a solid framework for that analysis.

Systems Approach to Understanding the Operational Environment

Throughout the majority of the 20th century and the Cold War, conflict between nation states was the expected norm. Today, that expectation has changed. Present and future adversaries are not limited to state actors and we find non-state actors, such as the al-Qaeda terrorist network, operating across complex, adaptive systems unconstrained by geographic boundaries. The 2005 NDS recognized and highlighted this change to the strategic environment and presented a new array of challenges that threaten U.S. interests. Figure 2 overlays the four priority areas identified for analysis during the 2006 QDR on those four challenges. Planning for and developing capabilities

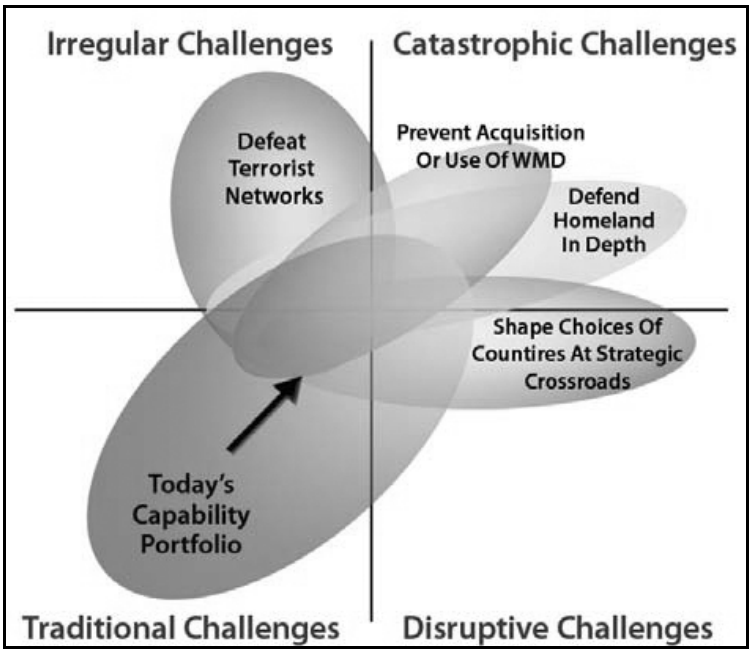

Figure 2. Challenges Described in the National Defense Strategy[39]

to support space control operations, like all other operations, should address one or more of these priority areas. That, however, is just the first step. Rather than simply focusing on application of the military instrument of power, today's complex operational

environment requires a new perspective--an effects-based approach that considers and employs all of the instruments of national power.[40]

In the U.S. Joint Forces Command (USJFCOM) *Commander's Handbook for an Effects-Based Approach to Joint Operations*, there is a deliberate focus on thinking differently about how best to employ national instruments of power. It emphasizes a broader and deeper understanding of the operational environment and a systems perspective of the operational area. "This understanding and thinking includes how to use the military instrument beyond just force-on-force campaigns, battles, and engagements."[41] This is especially appropriate for space control operations, as the concepts of force-on-force campaigns, battles, and engagements in space are just becoming a reality. Figure 3 graphically represents the operational environment as a series of related and interconnected systems: political, military, economic, social, infrastructure, and informational (PMESII). The systems are both military and non-military and this perspective offers a holistic view of the system's fundamental elements, or nodes, and their relationships, or links. Though the figure may appear to be a defined set of systems focusing on a potential state or non-state actor, it actually takes into account multiple friendly, adversary, and neutral or unaligned systems operating at the national strategic, theater strategic, operational, and tactical levels.[42] Not only does this systems approach help identify critical nodes and potentially decisive points; it also enables the identification of and the potential for higher-order effects given associated relationships and actions. Colin Gray, in his book *Modern Strategy*, echoed the importance of this type of systems approach to understanding the complexity of conflict

when he said, “war…has many dimensions--human, political, economic, ethical, geographical, military operations, and so forth.”[43]

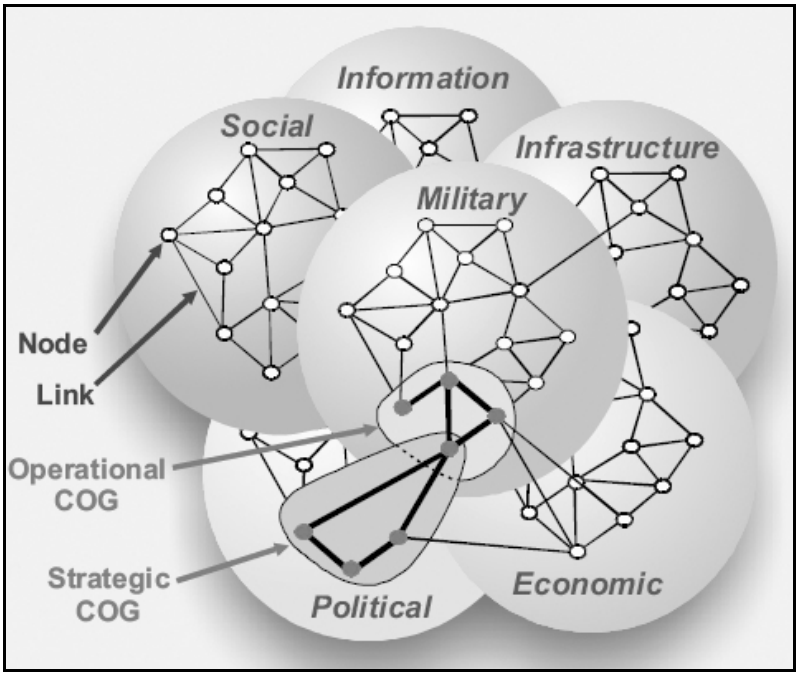

Figure 3. Systems Perspective of the Operational Environment[44]

The final portion of this paper breaks the six PMESII systems down and identifies a representative, but not exhaustive, set of strategic factors[45] that are likely to be significant during an analysis of the operational environment associated with space operations. It then concludes with an integrated example that illustrates the development of recommended policy options to support deterrence and dissuasion within the construct of the space control mission set.

Strategic Factors Associated with Space Operations

The development of any policy regarding space-based weapons should consider all relevant alliances, treaties, and international laws as political factors. Alliance and treaty relationships are formal relationships within and between systems operating in the operational environment and, as the Space Commission report concluded, a policy

of deterrence with regard to space, as with any domain, extends beyond just the U.S. system and potentially links to the policies of both allies and friends alike. Using the North Atlantic Treaty Organization (NATO) as an example of an alliance, combined planning allows for the development of a common appreciation of the threats, potential responses, and ultimately development of policy and plans to deter and defend against threats from space.[46] Closely related to international treaties, international law is another political factor that can directly influence a state or non-state actor's decision to develop, acquire, or employ capabilities to challenge our space capabilities. Just as exploration of the sea gave rise to new international laws that governed the new domain and resolved conflict, expanded operations in space will likely generate the same results. "As a commons, space demands continued engagement in the international arena. One must continually explore and update laws, treaties, and agreements to allow for effective growth while minimizing conflict."[47] Finally, national and organizational leadership, along with that leadership's willingness to act regarding space operations, including attack on or threat to space capabilities, is directly applicable and should be considered as a political factor.

Military factors include organic space capabilities, both on-orbit, terrestrial, and launch-related as well as any space control capabilities possessed by a potential adversary. Space-related military factors should not be limited to space systems, however; a detailed knowledge and understanding of the integration of space capabilities across the full range of military operations is important. Take for example SATCOM. The ability to distribute vast amounts of data in near-real time provides tremendous capabilities to our forward deployed joint operations and support forces,

and as such highlights to would-be adversaries a potential vulnerability they may decide to exploit. Some SATCOM capabilities are organic to the military, like the Milstar system[48], and others are commercial like Inmarsat, who provides mobile satellite communications to both civil and military users.[49] The same challenges that exist with SATCOM systems also exist in the area of overhead imagery suitable for intelligence purposes, especially given the improvement in the quality of commercial imagery.[50] States, as well as non-state actors, no longer need the ability to develop and operate their own space capabilities--all they need is a credit card and a link to the internet.

Economically, the evaluation of the operational environment should include factors that address the commercial relationships that provide space capabilities to any potential adversary. An adversary's membership in or reliance on international consortia or corporations to provide space capabilities and services on a regional or international level may be vital pieces of information as well as information on the adversary's broader economic situation and relationships. The 2007 Chinese ASAT test provides a good example for consideration. Several points of view exist regarding the possibility of dissuading China from deploying and using ASAT weapons in the future. Some recommend the U.S. hold broader political and economic cooperation at risk; however, this could be costly for other important U.S. interests. Others hold that economic interests and the need for cooperation with China on issues limit the degree to which the U.S. could dissuade China.[51]

Social factors address the population and leadership of potential adversary. Identifying the social dependency on space capabilities, and where the greatest dependence lies, provides vital insight necessary to assess the public's portion of the

cost and benefit analysis associated with policies to deter and dissuade. In order to deter an adversary, one must understand four factors that make up their decision-making process: their perception of the benefits of an action, their perception of the costs of an action, their perception of the consequences of restraint or inaction, and their risk-taking propensity.[52]

Information and infrastructure go hand-in-hand, especially when analyzing the operational environment with a focus on space operations. It is important to determine what paths and systems carry the information, redundancies to overcome, and vulnerabilities to exploit. In the 21st century, the ability to move, interact with, and control information has truly become a cornerstone of the global environment. Former Secretary of Defense Cohen, in his 1999 DOD Space Policy, highlighted that significance and said, “The globally interdependent information- and knowledge-based economy as well as information-based military operations make the information lines of communication to, in, through, and from space essential to the exercise of U.S. power.[53] The following integrated example further illustrates the utility of the PMESII systems approach and the ability of space control operations to support the National Space Policy’s requirement to preserve the U.S. right to freedom of operation in the space domain and to deter and dissuade others from either impeding those rights or developing capabilities intended to do so.

Dissuading or Deterring Space-based ASAT Weapons[54]

How can the U.S. dissuade a potential adversary from developing or deter from using a conventional, space-based ASAT capability? One option might be to deploy our own U.S. space-based ASAT weapons and make it clear to any potential adversaries

that any aggressive actions in space would result, from the aggressor's point of view, in an unacceptable outcome. That option, while credibly threatening to deny benefits or impose costs, does not meet the complete intent of the new definition of deterrence discussed earlier in this paper. Specifically, there is no attempt to encourage restraint by convincing the potential adversary such restraint will result in an acceptable outcome. Instead, a more effective policy to dissuade or deter space-based ASAT weapons would be based on an integrated view of the operational environment resulting from an analysis of each of the systems in the PMESII framework. Though this example will not complete that entire analysis, some highlights are provided to illustrate the key points.

As already mentioned, policies regarding space-based weapons should consider all relevant alliances, treaties, and international laws as some of the factors affecting the political system, and the 1967 Outer Space Treaty is one important example. Some nations, such as Russia and China, are proponents of United Nations efforts to expand the Outer Space Treaty from a ban on weapons of mass destruction (WMD) to a ban that prohibits all types of weapons from space.[55] This would most likely color the view of those two countries regarding any U.S. move to weaponize space and Peña and Hughes, in their article regarding space weaponization, termed it "virtually certain" that deploying U.S. weapons would lead to the deployment of ASATs by potentially hostile nations, such as China.[56] Before stepping back and addressing the key factors affecting the multiple systems that make up the operational environment, let us consider one potential future that could result if China followed the U.S. deployment with a space-based weapons capability of their own.

“Chinese moves to put weapons in space may trigger regional rival India to consider the same, in turn, spurring Pakistan to strive for parity with India, as they did in the development of nuclear arms. Even U.S. allies in Europe might feel pressure to keep up.”[57] While this sort of space arms race may appear to be political and military in nature, the higher-order effects generated across the interconnected international system-of-systems is not. Economics, social, infrastructure…they all become involved as the second- and third-order effects play out.

Consider for example, the economy of Pakistan may suffer significantly economically if they attempt to match India’s space capability or their economy may not support the development of space-based weapons at all. It is possible an arms race in space will further destabilize the region and potentially increase the risk of significant conflict between two members of the nuclear club.

An analysis of the operational environment before the U.S. embarked on a course of action to deploy a space-based weapon system would likely have highlighted other factors that influenced the course of action. Those factors, including political considerations such as the regional politics between China, India, and Pakistan as well as the economic factors that would better clarify what type of response is within the realm of the possible given fiscal constraints. Social factors would have been identified that provided the point of view of potential adversaries regarding likely responses to a unilateral U.S. move to deploy offensive weapons designed to permanently negate their space systems.

In summary, a thorough PMESII analysis of the operational environment would have likely resulted in a more acceptable policy from all points of view--either

completely meeting the intent of deterrence or identifying specific key nodes or interactions where effort could be placed to even potentially dissuade a country like China from developing disruptive technologies, such as an on-orbit ASAT system. Alternate space control strategies may, as a result of the PMESII analysis, be focused instead on defensive space control and the ability to protect U.S. and allied space systems. Those protection capabilities, along with other elements of the instruments of power such as information and diplomatic efforts, could result in an entirely different and more acceptable outcome. No matter what the solution, though, a complete systems analysis that considers the multiple interactions of the interacting system-of-systems would enable a more robust decision making process and provide vital insights into higher-order effects that may result from any action taken.

Conclusion

Today, the integration of space capabilities throughout national security, civil, commercial, and international sectors continues to grow. As the National Space Policy explains, “Space activities have improved life in the United States and around the world, enhancing security, protecting lives and the environment, speeding information flow, serving as an engine for economic growth, and revolutionizing the way people view their place in the world and the cosmos.”[58] Because of that integration and dependence, the need to secure and protect those capabilities are vital to our U.S. national interests. While the security environment of the 21st century has become more volatile, uncertain, complex, and ambiguous than that experienced through the decades of the Cold War, there remains a valid and vital need for policies designed to prevent conflict between adversaries. To address the changes in the operational environment a new tool,

dissuasion, is necessary to work in concert with deterrence and fill the "grey area" where it is not clear whether another state or non-state actor is a friend or foe. Meteyer's Defense Policy Spectrum, along with the new ideas regarding dissuasion and deterrence put forth in the DO JOC and NDS provide a new framework that should be incorporated across all joint and service doctrine, including that centered around space control and maintaining U.S. space superiority.

To enable development of effective and complete deterrent or dissuasion strategies, joint and service doctrine for space control operations should include a systems approach to the analysis of the operational environment based on the PMESII factors outlined by USJFCOM. The NDS points out that "as the character and composition of our principal challengers change, so too must our approaches."[59] Though complex in its own right, a systems-of-systems approach to understanding the internal and external relationships of systems operating at the national strategic, theater strategic, operational, and tactical levels provides a solid framework for policy development in anticipation of the need to change approaches. Finally, the same type of system-of-systems focused PMESII analysis should guide our joint and service efforts to protect our own vital space capabilities. By identifying our own key nodes and links, we can address our vulnerabilities before an adversary can exploit them.

Endnotes

[1] Phillip C. Saunders and Charles D. Lutes, "China's ASAT Test: Motivations and Implications," *Joint Forces Quarterly* (3rd Quarter 2007), 39; available from http://www.ndu.edu/inss/Press/jfq_pages/editions/i46/8.pdf; Internet; accessed 28 February 2008.

[2] U.S. Department of Defense, "DOD Succeeds in Intercepting Non-Functioning Satellite," DOD News Release No. 0139-08, 20 February 2008; available from http://www.defenselink.mil/releases/release.aspx?releaseid=11704; Internet; accessed 13 March 2008.

[3] This paper provides an in-depth case study of Program 437 and ASAT weapons in general. Additionally, it addresses the vulnerability of space-based assets and potential threats. Clayton K. S. Chun, *Shooting Down a 'Star': Program 437, the US Nuclear ASAT System and Present-Day Copycat Killers*, CADRE Paper No. 6 (Maxwell AFB: Air University Press, April 2000), xiii; available from http://aupress.au.af.mil/CADRE_Papers/PDF_Bin/chun.pdf; Internet; accessed 28 February 2008.

[4] William Spacy, II, "Assessing the Military Utility of Space-Based Weapons," in *Space Weapons: Are They Needed?*, ed. John M. Logsdon and Gordon Adams (Washington D.C.: George Washington University Space Policy Institute, October 2003), 184; available from http://www.gwu.edu/~spi/Security_Space_Volume.Final.pdf; Internet; accessed 28 February 2008.

[5] U.S. Department of Defense, *Soviet Military Power* (Washington, D.C.: U.S. Department of Defense, September 1990), 60.

[6] George W. Bush, *National Space Policy* (Washington, D.C.: White House, 31 August 2006), 1; available from http://www.ostp.gov/galleries/default-file/Unclassified%20National%20Space%20Policy%20--%20FINAL.doc; Internet; accessed 18 February 2008.

[7] David O. Meteyer, *The Art of Peace: Dissuading China from Developing Counter-Space Weapons*, INSS Occasional Paper 60 (USAF Academy: USAF Institute for National Security Studies, August 2005), 3; available from http://www.usafa.af.mil/df/inss/OCP/ocp60.pdf; Internet; accessed 26 February 2008.

[8] Patrick Rayermann, "Exploiting Commercial SATCOM: A Better Way," *Parameters* 33 (Winter 2003-04): 55; available from http://carlisle-www.army.mil/usawc/Parameters/03winter/rayerman.pdf; accessed 26 February 2008.

[9] For a more complete discussion of the inextricable integration of space capabilities in today's joint U.S. warfight, refer to the following two articles: George R. Farfour and Kenneth E. Yee, "No Space Capabilities--No Joint Fight," *High Frontier* 4 (February 2008): 37-40; available from http://www.afspc.af.mil/shared/media/document/AFD-080226-050.pdf; Internet; accessed 28 February 2008. Gary L. North and John Riordan, "The Role of Space in Military Operations: Integrating and Synchronizing Space in Today's Fight," *High Frontier* 4 (February 2008): 3-7; available from http://www.afspc.af.mil/shared/media/document/AFD-080226-050.pdf; Internet; accessed 28 February 2008.

[10] Kevin P. Chilton, "Securing Space," *Los Angeles Times*, 4 October 2007 [newspaper on-line]; available from http://www.latimes.com/news/opinion/la-oe-chilton4oct04,0,6082315.story?coll=la-opinion-rightrail; Internet; accessed 26 February 2008.

[11] Richard DalBello, "Commercial Communication Satellites: Assessing Vulnerability in a Changing World," in *Space Weapons: Are They Needed?*, ed. John M. Logsdon and Gordon Adams (Washington D.C.: George Washington University Space Policy Institute, October 2003),

271-296; available from http://www.gwu.edu/~spi/Security_Space_Volume.Final.pdf; Internet; accessed 28 February 2008.

[12] Bush, *National Space Policy*, 1.

[13] In President Wilson's 8 January 1918 address to Congress, he proposed a 14-point program for world peace. These points became the basis for peace negotiations at the end of World War I. His second point focused specifically on freedom of navigation on the seas and the importance of maintaining this freedom, outside territorial waters, in both peace and war. Woodrow Wilson, Message to Congress, Senate, 8 January 1918, Record Group 46, Records of the United States, National Archives; available from http://www.ourdocuments.gov/doc.php ?flash=true&doc=62; Internet; accessed 1 March 2008.

[14] Bush, *National Space Policy*, 1-2.

[15] U.S. Joint Chiefs of Staff, *Department of Defense Dictionary of Military and Associated Terms*, Joint Publication 1-02 (Washington, D.C.: U.S. Joint Chiefs of Staff, 12 April 2001 as amended through 14 September 2007), 160; available from http://www.dtic.mil/doctrine/jel/ new_pubs/jp1_02.pdf; Internet; accessed 19 February 2008.

[16] George W. Bush, *The National Security Strategy of the United States of America* (Washington, D.C.: White House, March 2006), 22; available from http://www.whitehouse.gov/ nsc/nss/2006/nss2006.pdf; Internet; accessed 18 February 2008.

[17] The DO JOC applies DOD's Capstone Concept for Joint Operations, the overarching concept that guides the development of future joint capabilities across the range of military operations, to U.S. joint force deterrence operations. The central idea of the DO JOC is to "decisively influence the adversary's decision-making calculus in order to prevent hostile actions against US vital interests." That decision-making calculus focuses on an adversary's perception of three primary elements: the benefits of a course of action, the costs of a course of action, and the consequences of restraint (i.e., costs and benefits of not taking the action we seek to deter). U.S. actions contribute to deterrence by affecting the adversary's decision calculus elements in three ways: deny benefits, impose costs, and encourage adversary restraint. U.S. Department of Defense, *Deterrence Operations Joint Operating Concept* (Washington, D.C.: U.S. Department of Defense, December 2006), 5-8; available from http://www.dtic.mil/ futurejointwarfare/concepts/do_joc_v20.doc; Internet; accessed 1 March 2008.

[18] *Merriam-Webster OnLine*, s.v. "dissuade;" available from http://www.merriam-webster.com/dictionary/dissuade; Internet; accessed 14 March 2008.

[19] U.S. Department of Defense, *Deterrence Operations Joint Operating Concept*, 73.

[20] U.S. Department of Defense, *The National Defense Strategy of the United States of America* (Washington, D.C.: U.S. Department of Defense, March 2005), i; available from http://www.maxwell.af.mil/au/awc/awcgate/nds/nds.pdf; Internet; accessed 26 February 2008.

[21] Meteyer, 13-16.

[22] Ibid., 24.

[23] Ibid., 23.

[24] U.S. Department of Defense, *Quadrennial Defense Review Report* (Washington, D.C.: U.S. Department of Defense, February 2006), 27-30; available from http://www.defenselink.mil/qdr/report/report20060203.pdf; Internet; accessed 19 February 2008.

[25] Kenneth N. Waltz, "The Spread of Nuclear Weapons: More May Be Better," in *Conflict after the Cold War: Arguments on Causes of War and Peace,* ed. Richard K. Betts (New York: Longman, 2002), 452.

[26] U.S. Department of Defense, *Deterrence Operations Joint Operating Concept*, 70-71.

[27] Waltz, 452.

[28] While not intended to a be a complete tutorial on joint and service space control doctrine, an overview of the mission and associated terms is an important precursor to a discussion of dissuasion and deterrence as methods for ensuring space capabilities. For a joint perspective on space operations, reference Joint Publication 3-14, *Joint Doctrine for Space Operations*. Though dated (a new version is currently in coordination), it does include a complete discussion of joint space doctrine and operations, including the space control mission area. U.S. Joint Chiefs of Staff, *Joint Doctrine for Space Operations*, Joint Publication 3-14 (Washington, D.C.: U.S. Joint Chiefs of Staff, 9 August 2002); available from http://www.dtic.mil/doctrine/jel/new_pubs/jp3_14.pdf; Internet; accessed 3 December 2007. For a more current discussion, focused specifically on space control operations, reference Air Force Doctrine Document 2-2.1, *Counterspace Operations*. U.S. Department of the Air Force, *Counterspace Operations*, Air Force Doctrine Document 2-2.1 (Washington, D.C.: U.S. Department of the Air Force, 2 August 2004); available from http://www.dtic.mil/doctrine/jel/service_pubs/afdd2_2_1.pdf; Internet; accessed 26 February 2008.

[29] Joint Publication 1-02, 499.

[30] Joint Publication 3-14, IV-6.

[31] Ibid., IV-7.

[32] Lorraine M. Martin, "Preparing for Conflict in Space: A New Perspective of the Joint Fight," *High Frontier* 4 (February 2008): 20; available from http://www.afspc.af.mil/shared/media/document/AFD-080226-050.pdf; Internet; accessed 28 February 2008.

[33] U.S. Department of the Air Force, *16th Space Control Squadron Fact Sheet*; available from http://www.peterson.af.mil/library/factsheets/factsheet_print.asp?fsID=8403&page=1; Internet; accessed 14 March 2008.

[34] Joint Publication 3-14, IV-7.

[35] U.S. Department of the Air Force*, 4th Space Control Squadron Fact Sheet*; available from http://www.peterson.af.mil/library/factsheets/factsheet_print.asp?fsID=4707&page=1; Internet; accessed 14 March 2008.

[36] Joint Publication 3-14, IV-7.

[37] Steven J. Lambakis, *On the Edge of Earth: The Future of American Space Power* (Lexington, KY: University Press of Kentucky, 2001), 169.

[38] The U.S. government purchased all rights to all the pictures of Afghanistan and surrounding areas taken by the Ikonos high-resolution imaging satellite operated by the Space Imaging, a Colorado-based U.S. company. The U.S. National Imagery and Mapping Agency (NIMA) "assured access to imagery in support of Operation Enduring Freedom." Under the terms of the contract, Space Imaging would not sell, distribute, share, or provide the imagery to any other entity. Although Ikonos images are sold commercially, the U.S. Government has the right to impose such restrictions, which are known as shutter control. David Whitehouse, "US Buys Afghan Image Rights," 17 October 2001; available from http://news.bbc.co.uk/1/hi/sci/tech/1604426.stm; Internet; accessed 14 March 2008.

[39] U.S. Department of Defense, *Quadrennial Defense Review Report*, 19.

[40] Instruments of national power are those means available to the government in its pursuit of national objectives. They are expressed as diplomatic, economic, informational, and military. Joint Publication 1-02, 266.

[41] U.S. Joint Forces Command, *Commander's Handbook for an Effects-Based Approach to Joint Operations,* (Norfolk, VA: Joint Warfighting Center, 24 February 2006); I-6; available from http://accsco.be/wp-content/download/5%20-USJFCOM%20-%20%20Commanders%20Handbook%20for%20an%20Effects-Based%20Approach%20to%20Joint%20Operations%20.pdf; Internet; accessed 1 March 2008.

[42] Ibid., II-2, II-4.

[43] Colin S. Gray, *Modern Strategy* (Oxford: Oxford University Press, 1999), 246.

[44] Ibid., II-2.

[45] For consistency in this paper, a "factor" is something that relates to, affects, or is associated with one of the PMESII systems defined in the USJFCOM system-of-systems approach to defining the operational environment.

[46] Space Commission, *Report of the Commission to Assess United States National Security Space Management and Organization* (Washington, D.C.: Space Commission, 11 January 2001), 29; available from http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA404328&Location=U2&doc=GetTRDoc.pdf; Internet; accessed 26 February 2008.

[47] John E. Hyten, "A Sea of Peace or a Theater of War? Dealing with the Inevitable Conflict in Space," *Air and Space Power Journal* 16 (Fall 2002): 82; available from http://www.airpower.maxwell.af.mil/airchronicles/apj/apj02/fal02/hyten.html; Internet; accessed 2 March 2008.

[48] Milstar is a joint service military satellite communications system that provides secure, jam resistant, worldwide communications for high priority military users. U.S. Department of the Air Force, *Milstar Satellite Communications System Fact Sheet*, January 2007, available from http://www.af.mil/factsheets/factsheet.asp?id=118; Internet; accessed 14 March 2008.

[49] Inmarsat is a global satellite communication corporation based in London, UK. *Inmarsat Home Page*, available from http://www.inmarsat.com; Internet; accessed 15 March 2008.

[50] DigitalGlobe's QuickBird satellite provides 0.6 m panchromatic resolution images available to commercial customers. DigitalGlobe Inc., *QuickBird Spacecraft Data Sheet*, available from http://www.digitalglobe.com/file.php/515/QuickBird_Datasheet_web.pdf; Internet; accessed 2 March 2008. Earlier commercial imagery satellites did not provide as high a quality images. For example, Landsat 7 image resolution was limited to 15 m and SPOT Image's SPOT 4 image resolution was limited to 10 m. Larry K. Grundhauser, "Sentinels Rising: Commercial High-Resolution Satellite Imagery and Its Implications for US National Security," *Air and Space Power Journal* 7 (Winter 1998): 62; available from http://www.airpower.maxwell.af.mil/airchronicles/apj/apj98/win98/grund.pdf; Internet; accessed 14 March 2008.

[51] Phillip C. Saunders and Charles D. Lutes, "China's ASAT Test: Motivations and Implications," *Joint Forces Quarterly* 46 (3rd Quarter 2007): 45; available from http://www.ndu.edu/inss/Press/jfq_pages/editions/i46/8.pdf; Internet; accessed 28 February 2008.

[52] U.S. Department of Defense, *Deterrence Operations Joint Operating Concept*, 20.

[53] U.S. Secretary of Defense Bill Cohen, "Department of Defense Space Policy," memorandum for the U.S. Department of Defense, Washington, D.C., 9 July 1999, 2; available from http://www.au.af.mil/au/awc/awcgate/dod-spc/dodspcpolicy99.pdf; Internet; accessed 26 February 2008.

[54] The scenario used in this section was adapted from one used in Theresa Hitchens' paper on the policy implications of space-based weapons. Theresa Hitchens, "Weapons in Space: Silver Bullet or Russian Roulette? The Policy Implications of U.S. Pursuit of Space-Based Weapons," in *Space Weapons: Are They Needed?*, ed. John M. Logsdon and Gordon Adams (Washington D.C.: George Washington University Space Policy Institute, October 2003), 139; available from http://www.gwu.edu/~spi/Security_Space_Volume.Final.pdf; Internet; accessed 3 December 2007.

[55] Ibid., 138.

[56] Charles V. Peña and Edward L. Hudgins, "Should the United States 'Weaponize' Space? Military and Commercial Implications," *Policy Analysis* (18 March 2002): 10; available from http://www.cato.org/pubs/pas/pa427.pdf; Internet; accessed 15 March 2008.

[57] Hitchens, 139.

[58] Bush, *National Space Policy*, 1.

[59] U.S. Department of Defense, *The National Defense Strategy of the United States of America*, 9.